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ABSTRACT

This paper proposes a framework for supporting the authoring process of distance learning courses. An overview of distance learning courses and the World Wide Web is presented. The proposed framework is then described, including: (1) components of the framework--a hypermedia design methodology for authoring the course, links to related Web sites, a set of Internet tools, a site specifying kinds of student assessments, a site indicating students' tasks, and links to a set of software and other executable resources needed for students' work; (2) the Object-Oriented Hypermedia Design Method (OOHDM), a model-based approach for building hypermedia applications that comprises four activities--conceptual design, navigational design, abstract interface design, and implementation; (3) modeling of the design of a distance learning class on object-oriented technology; (4) implementation issues, including Internet tools and evaluation questions; and (5) future work. Four figures present the distance learning course framework, the OOHDM conceptual model, OOHDM node class views, and the OOHDM navigational scheme. (MES)

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Distance Learning Courses on the Web: the Authoring Approach

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Abstract: Emerging educational scenarios propose to try together new forms of distance learning and networking capabilities. Moreover, these scenarios are only sketched, suggesting that soundest conceptual frameworks must be designed for improving available networking tools. In this paper, we propose a framework for distance learning courses, which current focus is the authoring process. Educational applications embrace pedagogical specifies and goals, needing strong support for the authoring process. Aiming to test a design methodology behavior face an educational application to be delivered on the WEB, we modeled a distance learning course about "OO Technology".

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1. Introduction

Evolving information technology demands new knowledge and skills. Distributed educational hypermedia delivered via WWW can become effective way to access education resources. The rapid expansion of the Web makes people on the need of continuing education. Moreover, organizations are becoming geographically dispersed and networked. Training is turning financially impractical to bring participants together in the same classroom. All these factors accent the need of deliver education material in a distributed way.

Distance learning has always taken advantage from the development of communication technologies. In the past, post service and new forms of mail delivery have allowed a rise of courses by mail. Today the networking technologies are playing the same role: in developed countries, the technological development already available or currently under development will result in a useful and friendly desktop computer in every home. This development will be available on a mass scale within the next 10 years. The networking technologies are becoming the main focus point of a distance learning system. Facing the networking technologies' growth, innovative distance learning scenarios must be drawn.

Emerging educational propose to try together new forms of distance learning and networking capabilities. Moreover, these scenarios are only sketched, suggesting that soundest conceptual frameworks must be designed, for improving available networking tools and services.

In this work, we propose a framework for supporting the authoring process of distance learning courses. The paper is organized as follow: section 2 presents briefly Web-based distance learning courses; in the section 3, the proposed framework is presented and details about how to design a course are shown. We also present the use of the design methodology OOHDM adapted to model this kind of courses. A course, about Object Oriented Technology, is modeled, aiming to illustrate how pedagogical strategies can be related with design decision. Section 4 offers our conclusions and further works.

2. Distance learning Courses and the Web

The Web is an effective tool for providing information to individuals, teachers, administrators and others. Access to learning resources has never been as easy as it is today. Participants could acquire material from

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whatever place by clicking on the screen. Internet today provides a wide set of tools like, web browsers, ftp clients, emails clients that become easier the learning process in a distance learning environment. Nowadays, there are millions of users sharing experiences, products and projects on the Web and a lot of them are accessing distance learning materials.

The Web provides a set of standards for handling a wide variety of media types, browser software and server environments that can be integrated fruitfully into a framework that allows a collaborative learning process among students. However, building these kinds of interactive WWW application requires Web browser powered. From a distance learning point of view WWW environment must be more flexible and dynamic and enable one to customize if it is necessary. Java opens up these possibilities by allowing programs to be sent over the Web [Hardlin & Ziebarth, 1995].

Besides the delivering of instructional material, Web-based courses allow asynchronous and synchronous collaboration among peers, real communication among teacher-students and students-students; and a wide access to complementary instructional materials on-line. These features make the Web a rich and powerful learning environment. A critical aspect for developing distance courses seems to be what we can and what we can not simulate of the real classrooms, but overcoming their conventional approach. The Internet provides tools and software applications that enable us to mimic remotely important components of real classes, in addition to features provided by the Web.

Moreover, the success of distance learning courses lays on an effective authoring design. Distance courses must present well-organized contents and clarify the user's pre-requirements, the kinds of student assessments, the ways of interaction among peers, answer-judging procedures and safe and clear manners of communication with the teachers. As result, the design of web-based courses has to be carried out by domain experts, hypermedia experts and skilled instructional designers. During the whole design process it is important keep in mind that students will be working remotely, so they will be alone.

Educational applications embrace pedagogical specifications and goals, needing strong support in the authoring process. Hypermedia models can provide a convenient approach for accessing educational resources and bring us the ability to customize courses, according to customer needs. The diffusing Web brings to the users the opportunity to access to the educational material when and where they want. Therefore, there are striking authoring features that must be improved, but using hypermedia models, the authoring process becomes better.

3. Framework for Distance Learning Course on the Web

Designing and developing web applications is a complex task that involves a variety of activities, either at the storage level, access level and presentation level. As result, the constituencies participating in hypermedia projects differ from those of traditional software development environments. Hypermedia projects involve content-authors, musicians and graphic designers, as well as programmers, software managers, and users. Moreover, aesthetic and cognitive aspects, so important for hypermedia applications, are foreign to existing software engineering environments. Thus, there is a need for special methodologies and tools to support the software development process of hypermedia applications [Díaz et al., 1996].

On the other hand, building an educational hypermedia has differences with conventional ones. Conventional hypermedia systems have a definable structure to be modeled. Educational ones have to deal with abstract concepts and have a high grade of interaction.

To minimize this complexity, frameworks and authoring systems for helping the developing and delivering of distance learning courses have being presented, such as [site Habanero], [site Web Course in a Box], [site Top Class] and [site WebCT]. Therefore, both frameworks and authoring systems neglect the courses authoring process. We propose a framework for distance learning, which core is the authoring process of courses [Fig. 1]. The framework is composed of:

- a hypermedia design methodology for authoring the course which help the building of the nodes and links network;
- links to related Web sites;
- a set of Internet tools;
- a site specifying the students kinds of assessment;

- a site for indicating the students tasks; and
- links to a set of software and other executable resources needed for students work.

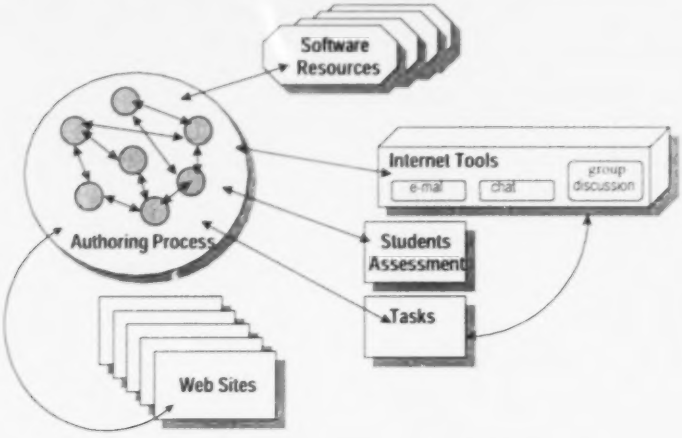

Figure 1: Distance Learning Course Framework

In this work, we detail the authoring process and offer an overview of the other components of the framework. In order to model distributed educational hypermedia, we also propose to use a flexible hypermedia design model - OOHDM [Schwabe & Rossi, 1995]. To show how OOHDM works we designed an Object Oriented Technology course.

3.1 The Educational Hypermedia Design Process

Authoring educational hypermedia application is a critical point. The author must follow the educational goals and an instructional approach for creating associative and meaningful links among nodes. Nodes could support individuals knowledge webs. The complexity of the authoring process demands effective design models. Considering the complexity of developing Web-based applications and the pedagogical specifies of educational hypermedia, we include in the framework a well known and reported model - Object-Oriented Hypermedia Design Method. The OOHDM - Object-Oriented Hypermedia Design Method, is a model-based approach for building hypermedia applications. It comprises four different activities: conceptual design, navigational design, abstract interface design and implementation.

Conceptual Design: during this activity, a model of the application domain is built using well known object-oriented modeling principles, augmented with some primitives such as attributes, perspectives and sub-systems.

Navigational Design: in OOHDM, an application is seen as a navigational view over the conceptual domain. This reflects the point of view that one of the keys distinguishing features of hypermedia applications is the notion of navigation. Different navigational models may be built for the same conceptual schema thus expressing different views (applications) on the same domain. In OOHDM, there is a set of pre-defined types of navigational classes: nodes, links and access structures. The semantics of nodes and links are the usual in hypermedia applications while access structures may represent alternative ways of accessing nodes.

Abstract Interface Design: once the navigational structure has been defined, it must be made perceptible to the user through the application's interface, which is done in this step by defining an abstract interface model. This means defining which interface objects the user will perceive, and in particular the way in which different navigational objects will look like, which interface objects will activate navigation, the way in which multimedia interface objects will be synchronized and which interface transformations will take place. A clean separation between both concerns, navigational and abstract interface designs.

Implementation: to obtain a running implementation, the designer has to map the navigational and abstract interface models into concrete objects available in the chosen implementation environment.

OO Technology: An Example Design: In the first step, we define a conceptual design. The output is illustrated in [Fig. 2]. We can see entities of the application domain and relationship between them. In our example, appear entities such as *class*, object, method, polymorphism and others that would be studied by the learner. Domain specialist is involved in this step.

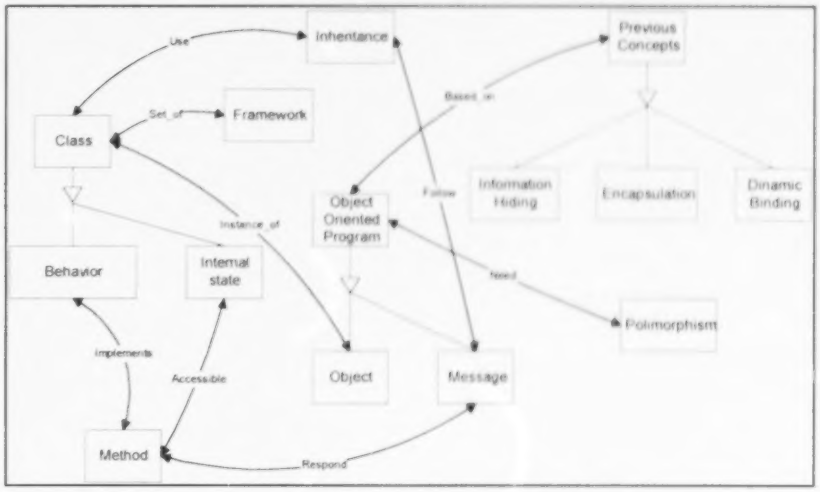

Figure 2: OOHDM - Conceptual Model

Conceptual classes may also be built using aggregation, for example node class *Class* is composed by *Behavior* and *Internal State*. Notice that it is a simplified version of the conceptual model, in a complete version, attributes for each node class we must be added. In the second step, the information represented in the conceptual model is reorganized to achieve the navigational model. We define the intended users establishing a set of operations for each of them. In OOHDM this is accomplished defining views of the conceptual model.

In our example we have two kinds of user: Initial Learner and Advanced Learner. Every node class shown in the [Fig. 3] has two views, one to be used when the learner is an initial student and the other to be used when it is an advanced one. Figure 3 shows a subschema taken from the model of [Fig. 2], and it represent the navigational space experimented by a initial learner.

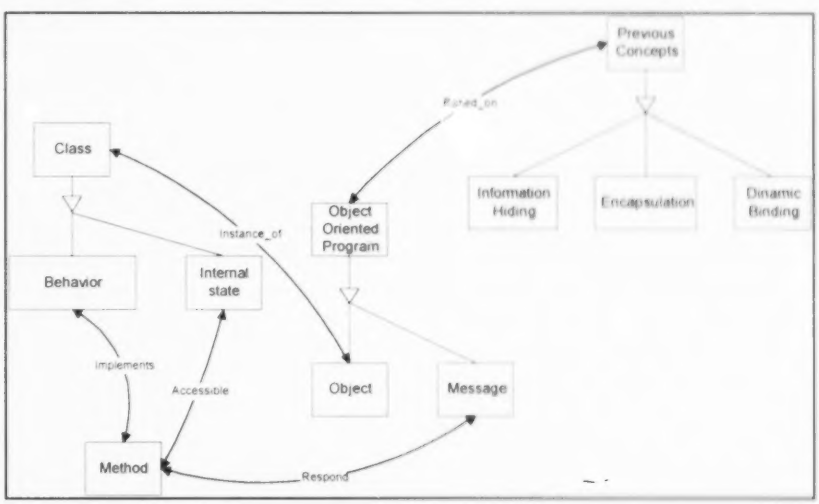

Figure 3: OOHDM- Node classViews

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In [Fig. 4] we illustrate the navigational schema for the course of Object Oriented Programming. Next, we define the navigational contexts, and the navigational classes related to these contexts. It allows us to see each class of the conceptual design.

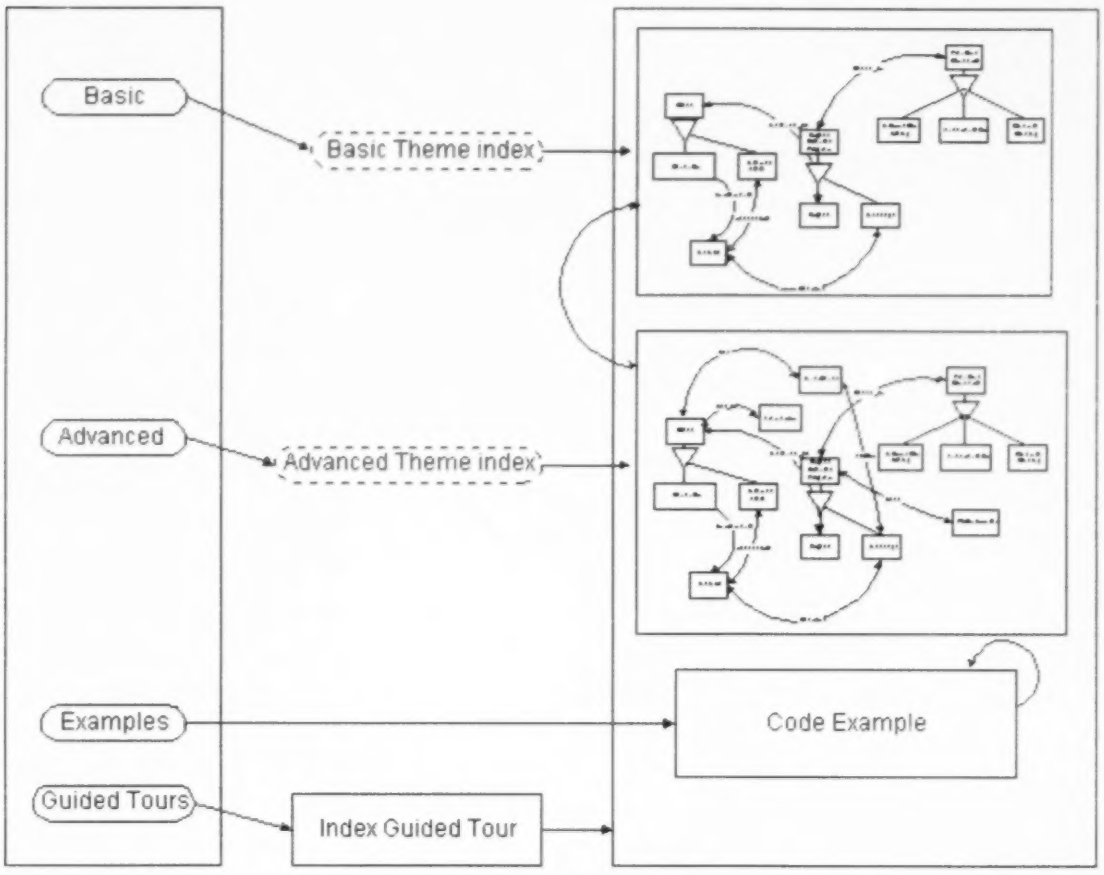

Figure 4: OOHDM - Navigational Scheme

3.2 Implementation Issues

Until a few years ago, software developing in the Internet was a hard task. The improvement of programming language, such as JavaScript, and some ease-to-use new features, such as available plug ins and applets Java, have turned the WEB environment more stable and robust.

The proposed framework runs over a Web browser, and integrates available communication and collaboration tools via Internet protocols such as: FTP (File Transfer Protocol) for downloading files, NNTP (Network News Transfer Protocol) for accessing discussion groups, POP 3 (Post Office Protocol) for accessing electronic mail and IRC (Internet Relay Chat) for conducting multi-user meetings (chat).

For helping the authoring process of distance learning courses, the framework provides a Web link to the OOHDM site and, in a near future, we are intending to integrate an automated tool - the RMCase [Diaz et al. 1995]. Other features of the framework are being implemented as HTML pages and forms.

Distance learning courses in the framework are Web sites composed of HTML pages and forms, added to some synchronous and asynchronous cooperative tools available in the Internet. Since it is already hard to

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reach real interaction in the Internet, the interaction was been placed in cooperative virtual spaces. A set of cooperation and communication tools was integrated to applications via Internet protocols. In the framework, distance learning courses include improving students learning process, giving them an active participation and letting to maintain contact with teachers and other students through electronic mail, discussion groups and chat sessions for questions or comments about the instruction.

Our first distance learning course - OO Technology, is just modeled. Then, we do not know the students' aptitudes face the distance learning approach and some questions arise:

- Will the users learn better with this approach?
- Will they work cooperatively?
- Will distance learning improve their autonomy?
- How to assess their performance?
- How to avoid the disorientation and cognitive overhead when they are exposed to the WEB?
- How much time professors will must to spend logged in the Internet to supervise and help users?

4. Conclusions and Further Works

The Internet expanding and the need for distance learning are bringing new educational challenges. We are facing this challenge and have started the developing and delivering of distance learning courses in hypermedia format.

The emphasis of our work is the belief that a strong authoring process can result in well-designed distance learning courses. The modeling of OO Technology course shows how pedagogical strategies are related to design process. OOHDM gives the necessary support for the process of designing the OO Technology course. The chosen methodology supports pedagogical specifies found in educational hypermedia and performs well in networking environment, since all its modeling steps keep independence from hardware and software platform.

Further works are related to:

- refine, implement and evaluate all framework features;
- test the distance learning course effectiveness and consistency, both in pedagogical and computational points of view; and
- verify the reuse level of the OOHDM conceptual design for developing other similar courses.

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